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ABSTRACT

A discussion of grammatical disorders in aphasia considers an area of ambiguity. In the work of one researcher, impairment of logico-grammatical relations is associated with semantic aphasia, not efferent-motor aphasia. In Western studies, efferent-motor aphasia is associated with impaired comprehension and production of grammar. In order to resolve this contradiction, the study attempts to distinguish different components in grammatical processing that could account for failures on a common processing task in two aphasia types, fluent and non-fluent. The lexical functional theory of grammar is used as a basis for analysis of data from a 1981 study. It is concluded that, consistent with earlier observations, it is fluent, not non-fluent patients, who have difficulty in assessing logical relationships in sentences, and that the distinction between disorders in fluent and non-fluent aphasia is not one of simple contrast between impaired lexicon and impaired syntax. Further research is recommended. A 22-item bibliography is included. (MSE)

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THEORIES OF AGRAMMATISM

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There is an area of ambiquity in the definition of qrammatical disorders in Luria's syndromes of aphasia and in current American-Western European syndromes. Specifically, impairment in the comprehension of loqico-grammatical relations is associated by Luria (1975) with semantic aphasia not with efferent-motor aphasia, whereas Western studies have focussed on Broca's aphasia (the equivalent of efferent motor aphasia) as beinq the syndrome in which there is impaired comprehension of qrammar, as well as impaired production of grammar. The ambiguity is reinforced when identical tasks are used to assess the deqree of aqrammatism in comprehension in Broca's aphasia and to examine the deqree of loqico-qrammatical impairment in semantic aphasia. Schwartz, Saffran and Marin (1980) have, for example, used Luria's task of askinq patients to show comprehension of sentences describing the relative locations of qeometrical shapes ("Point to 'The circle is above the square'"). Difficulty with such a task is considered to be characteristic of semantic aphasia by Luria, while Schwartz and her colleaques draw attention to its dependence on the ability to process word order and to comprehend the contextual meaning of one kind of function word (preposition), both of which abilities are said to be impaired in the aqrammatism of Broca's aphasia. To resolve such apparent contradictions it would clearly be desirable to distinquish, if possible, different components in grammatical processing which could account for failures on a common task in two types of aphasia. This could assist in the specification of a psycholoqically valid model of the mental processes which contribute to the production and comprehension of qrammar.

A current linguistic theory is worth considering in this respect for the light it may throw on such processes. This is Lexical Functional Grammar, as described by Bresnan (1978, 1982). This grammar is unusual in linquistics in making the specific claim that it is psycholoqically real. It therefore asks to be tested empirically as an account of how qrammar is pro-

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cessed in normal speaker-hearers, in children acquiring language and in language-disordered patients. Some attempts to do this have been reported by Ford (1982), Pinker (1982) and Zatorski and Lesser (1981).

Lexical Functional Grammar proposes that many grammatical functions are inherent in the lexicon rather than requiring specifically syntactic manipulations. All but a few operations which require the ordering of words in surface structure (e.g. the movement of words in inverted questions) can be accounted for in terms of argument structures in predicative words which are mapped directly onto grammatical functions. The grammar makes a distinction between the constituent structure of a sentence (its phrase structure and parts of speech such as noun and verb) and its functional structure (the grammatical relations of subject, object, complement etc, and such aspects as tense, number and gender). Functional structure combines grammatical functions with logical argument structures. The lexical entry for each verb or other predicative word specifies both its syntactic context and its functional structure. The difference between the specification for constituent structure context and that for functional structure can be illustrated with the verb "eat". In its intransitive form ("The cat is eating") it retains a logical object in its functional structure even though this is not realised in the syntactic context. This notion of functional structure is used to describe how passive verbs exist in their own right as lexical entries, rather than through transformation from a prototypical active form. "The cat was eaten" has a functional structure of

$$(\exists x)\ x\ \text{EAT}\ NP_1$$

compared with that of "The cat was eating" which has a functional structure

$$(\exists y)\ NP_1\ \text{EAT}\ y$$

Although both have distinct functional structures, their syntactic contexts are the same, i.e.

$$V,[-]$$

since they are both intransitive. In contrast, however, the transitive form of "eat" has the syntactic context of

$$V,[-NP]$$

and a functional structure of

$$NP_1\ \text{EAT}\ NP_2$$

The functional structure of each word relates only to such logical arguments as can be assigned a limited number of basic grammatical functions such as Subject, Object and Complement. It does not include logical or semantic entailments. Bresnan gives the examples of "escape", which logically entails a time, place and manner, but she notes that temporal locative and

manner adjuncts are not part of the functional structure of thematic roles such as Source, Theme and Goal. For example, "give", which has three logical arguments in its structure corresponding to Subject, Object 1 and Object 2, has entries for two distinct functional structures which allow it to be used in a double-object constituent structure ("John gave the baby a toy") or a to-object structure ("John gave a toy to the baby").

We can therefore distinguish three aspects of the information which needs to be stored in the lexicon for each predicative word i.e. its semantics, its functional structure and its permissible syntactic contexts. A relevant question for neurolinguistics is whether the logico-grammatical deficits of Luria's semantic aphasia and the grammtical deficits of efferent motor (Broca's) aphasia can be distinguished along these lexical dimensions.

Even to consider such possibility as the essential impairment in Broca's aphasia including a lexical dimension, we are subscribing to the current view that agrammatism in speech reflects a disruption in central language abilities which affects comprehension as well as production. This claim of a loss of grammatical competence has been made by Berndt and Caramazza (1981). The experimental evidence which supports this claim relies heavily on a distinction between two classes of words in the lexicon: open-class words ("content words", or "substantive words" i.e. nouns, verbs, adjectives and some adverbs) and closed-class words ("functors" or "grammatical words" i.e. prepositions, articles, pronouns, auxiliary verbs, grammatical inflections, etc). The latter group is extremely heterogenous in nature, and there is no single linguistic principle which underlies the pragmatic distinction between open- and closed-class words; indeed even the assumption that closed-class words form a finite non-expandable group has been questioned. Nevertheless the distinction has some pragmatic value. It has been proposed that closed-class words play a role in the parsing of sentences during comprehension (see Marcus 1982). This notion has found an application in the representation of grammar as an Augmented Transition Network (Kaplan 1972), in which the structure of a temporally encountered sentence is decoded by the closed-class items which specify the roles which are to be played by the open-class lexical items. Zurif (1980) claims that the agrammatic comprehension of Broca's aphasia is due to the loss of this parsing ability, the mechanisms for which are located in the anterior region of the left cerebral hemisphere. Since, however, many agrammatic patients are sensitive to the semantics of some closed-class words (e.g. pronouns) particularly when presented in isolation, it has been further argued that there may be dual representation of closed-class words in the brain: they

are represented posteriorly in the semantic lexicon together with the open class words, as well as being represented anteriorly in their parsing role. The basis for this claim was Bradley, Garrett and Zurif's (1980) work using a lexical decision task in which subjects' reaction times were compared for non-words which incorporated a closed-class item (e.g. "sucherty") or an open-class item (e.g. "worderty"). Normal subjects' times were reported to be uninfluenced by the frequency in the language of the closed class items, although the frequency of the open-items had its expected influence. Broca's aphasics were, however, influenced by frequency with both types of items. This evidence has recently been questioned by Gordon and Caramazza (1983). They argue that closed-class words tend to be of much higher frequency than open-class words, and that this could have accounted for the lack of influence of frequency with the normal subjects due to a ceiling effect; Broca's aphasics in contrast are more sensitive to frequency and therefore showed this even with the closed-class words. At all events Gordon and Caramazza's reduplication of Bradley et al.'s study was unable to replicate their findings. There is no firm support, therefore, from these studies for the claim that the reduction in comprehension in agrammatism is due to a selective malfunction of part of the lexicon.

An alternative account is Kean's (1977) interpretation of the disorder in Broca's aphasia as being phonological rather than syntactic. She observed that these patients have considerably less difficulty in using closed-class words when they are stressed than when they are unstressed, and argues that the true linguistic distinction is between phonological words (carrying stress) and clitics (unstressed). This theory has some attractions in that it provides a link between the segmental phonemic and phonetic disorders which often occur in Broca's aphasia and this proposed disorder of phonological representation at a more abstract level. Kean's theory, however, is not able to dispose of the argument that there are elements in agrammatism which cannot be accounted for in phonological terms. The theory would predict that agrammatic patients should have no difficulty in assembling structures which consist entirely of phonological words, without clitics. Kolk (1978) was able to show, however, that Broca's aphasics have as much difficulty in recognising the syntactic links between adjectives and nouns as between articles and nouns. There must therefore be some difficulty in constructing sentences in agrammatism which cannot be explained in terms of phonological clitics. The observations of Goodglass et al. (1979) point in the same direction. They reported that Broca's aphasics understood expanded sentences, (which incidentally used more closed-class words) better than

embedded ones with the same semantic content e.g. "The man was greeted by his wife and was smoking a pipe" compared with "The man greeted by his wife was smoking a pipe".

A possible reconciliation of the two accounts is that there are two types of agrammatism. In one type production and comprehension of grammatical morphemes is retained, within the limits of phrase boundaries, but the ability to assemble grammatical constituents at the clause or sentence level is impaired. In the other type grammatical morphemes are not available for the patients' use, although grammatical relationships may be expressed and understood through word order conveying the basic relationships of Subject, Object, Complement. This latter deficit results in telegraphic speech consisting in the juxtaposition of uninflected open-class words. The former deficit in contrast results in short phrases which remain as fragments of sentences although they employ grammatical inflections and closed-class items. Saffran, Schwartz and Marin (1980) cite an example of such a patient. So far no detailed linguistic study testing this hypothesis has been published. One factor which obscures an analysis simply in terms of surface structure is that Broca's aphasics either spontaneously or as a result of therapy often adopt strategies to compensate for their difficulties which include the stereotypic use of phrases which include closed-class words (Hand, Tonkovich and Aitchison, 1979). Moreover, there are also differences between the sentences which are available to them as spontaneous comments and those which they can construct deliberatively as propositions.

Nevertheless it is at least worth considering whether in some agrammatic patients the disorder is not phonological, nor related to the use of closed-class words, nor indeed one of surface structure assembly, but is rather in the realisation of functional structures in predicative words, such as are described in Lexical Functional Grammar. The alternative hypothesis would be that use of these functional structures is impaired in semantic aphasia rather than in agrammatism, and that they are therefore as a psycholinguistic process more aligned to semantics than to syntactic contextualisation.

An unpublished study by Lesser and Varley in 1981, undertaken as an undergraduate project in Newcastle by the second author, attempted to throw some light on the role of functional structures in patients classed by their speech therapists according to their spontaneous speech as "fluent" or "non-fluent", and therefore broadly aligned as to presumed posterior or anterior damage. Two control groups were also used: relatives of the patients, with no known brain-damage, and people with damage to the right

cerebral hemisphere. All the groups were tested on their ability to make the correct choice of picture for heard sentences, which differed in the types of verbs or adjectives used. One type of verb had implications of directional motion e.g. "lead", "follow". Another was non-directional but implied (in the picture context used) an aggressive action, e.g. "shoot", "kill". A third type of sentence used adjectives followed by to-complements which had either active or passive relationships to the subject of the sentence e.g. "The donkey is inclined to kick" "The donkey is fun to kick". These complements all used non-directional verbs. All sentences were six words in length, so as to control for load on short-term auditory verbal memory. The first two types of sentences were reversible, and the picture choice presented to the subjects showed the correct illustration and its reversed contrast. Both should be difficult for non-fluent patients if Saffran et al.'s (1980) hypothesis is correct that the processing of word order is difficult for such patients. They differed essentially on a semantic dimension - that between directional-motion verbs and non-directional verbs - but their functional structures were the same i.e.

$$NP_1 \text{ FOLLOW } NP_2$$

$$NP_1 \text{ KILL } NP_2$$

The third type of sentence contrasted with both in functional structure, which was more complex, being either like

$$NP_1 \text{ BE INCLINED TO } (\exists y)\ NP_1 \text{ KICK } y$$

or like $$NP_1 \text{ BE FUN TO } (\exists X)\ x \text{ KICK } NP_1$$

The hypothesis tested was that if the non-fluent patients had an agrammatism at constituent structure level, they would make more errors with the sentences which require word order to be processed than those which have the more complicated functional structure. If their agrammatism was at the level of functional structures, the reverse would be found. In either case, however, the semantic distinction between directional and non-directional verbs should not materially influence them. The fluent patients on the other hand should show this effect of verb semantics. As well, if their lexical impairment also included an impairment in the functional structure of the lexical items they should find the to-complement sentences harder than those with simple functional structures.

The results of this experiment, reported in more detail in Lesser (in press), showed that the non-fluent patients experienced the same pattern of difficulty as the cotrol subjects, although making more errors. The fluent subjects did indeed show an effect of verb semantics, in that the verbs of directional motion produced more errors than did the non-directional-verbs.

It was the fluent aphasics, and not the non-fluents, who made significantly more errors on the to-complement structures, a pattern also shown by the right-brain damaged subjects, although overall this group performed better than either of the aphasic groups.

The results of this study are consistent with Luria's observations that it is fluent patients who have difficulty in assessing logical relationships in sentences, rather than the non-fluent patients. Schnitzer (1982) has also claimed that it is Wernicke's area which handles basic predicational functions and that this is the area in which the brain puts "cognitive matter" into lexical predicational form.

The distinction between disorders in fluent and non-fluent aphasia is therefore not one of a simple contrast between impaired lexicon in the first and impaired syntax in the second, as Von Stockert (1976) has proposed. Jones (in press) has demonstrated in a task similar to Lesser and Varley's that patients classed as agrammatic can be influenced by verb semantics in that reversible sentences using non-directional verbs can be harder to understand than reversible sentences using non-directional verbs. Schwartz et al.'s study (1980) has also shown the influence of a semantic factor (animacy) on comprehension in Broca's aphasia. It seems therefore that all types of aphasia are sensitive to semantic influences, a finding which should hardly surprise us. From Lesser and Varley's study it also seems that fluent patients may be influenced by what according to Lexical Functional Grammar are grammatical aspects of the open-class lexicon. The problem in the agrammatism of Broca's aphasia seems to be one of organising constituent structure rather than of understanding functional relationships, but the disorder of constituent structure is clearly not a simple question of manipulating and processing word order. The precise specification of this difficulty in agrammatism, lying as it does between lexical functions and the binearly ordered assembly of words, is yet to be made.

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